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NAVFAC IGS-03410 (APRIL 2003)  
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Preparing Activity: LANTNAVFACENGCOM Supercedes IGS-03410(01/03)  
Based on UFGS-03410N

# ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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## SECTION 03410

### PLANT-PRECAST STRUCTURAL CONCRETE 04/03

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NOTE: This guide specification is issued by the  
Atlantic Division, Naval Facilities Engineering  
Command for regional use in Italy.

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NOTE: This guide specification covers the  
requirements for precast non-prestressed concrete  
used for structural purposes (planks, columns, etc.)  
and for minor architectural purposes (copings,  
window sills, etc.) in building and waterfront  
facilities construction. This guide specification  
does not cover precast concrete wall panels (Section  
03450, "Plant-Precast Architectural Concrete"),  
major precast non-prestressed architectural  
concrete, or precast concrete which is site  
manufactured and shall not be used for bridge or  
roadway construction. Precast concrete sound fences  
should be considered in lieu of block walls for use  
where sound barriers are used for noise abatement.

Comments and suggestion on this specification are  
welcome and should be directed to the technical  
proponent of the specification. A listing of the  
technical proponents, including their organization  
designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer  
choices or locations where text must be supplied by  
the designer.

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NOTE: The following information shall be shown on  
the project drawings:

1. Live and dead loads, and whether the topping is included in the dead load.
2. Details of fitting, bearing, and connections.
3. Location of expansion and control joints.
4. Style and area of steel fabric reinforcement in areas where required. Kind and size of reinforcing bars and spacing.
5. Strength and type of concrete.
6. Detail of placement of sealant or fillers in joints.
7. Fire rating.
8. Lightweight concrete unit weight.
9. Special requirements for concrete cover over reinforcing.
10. Areas where toppings are required, indicate areas where the full thickness of the topping is not present.

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## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

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NOTE: Italian laws and normatives are the legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

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Law 595	(26 May 1965) Technical characteristics for hydraulic binders
Law 1086	(5 November 1971; Rev. 1983) Technical norms for the calculations, executions and

testing of norms and prestressed  
reinforced concrete structures and metal  
structures

D.M. 9/1/96

(9 January 1996) Technical norms for the  
design, execution and testing of  
cast-in-place reinforced concrete,  
pre-cast prestressed reinforced concrete  
and steel structures

D.M. 16/1/96

Technical norms relative to general  
criteria for building safety verification  
and for loads and superimposed loads

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

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**NOTE: A UNI Norm is a technical normative  
recognized as Italian Law, submitted by a private  
organization "Ente Nazionale Italiano di  
Unificazione" for Italy and is available only in  
the Italian language. It is the National Standard.**

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UNI 3160

(1983) Special, wear-resisting steel sand  
castings - Qualities, requirements and  
tests

UNI 3740-1

(1999) Steel Fasteners - Technical  
specifications - Generalities

UNI 5294

(1978) Mechanical tests of ferrous  
material - Reverse bend test for steel  
wires

UNI 5591

Thick hexagon nuts(special purpose) - ISO  
metric coarse thread, Finish A

UNI 5592

(1968) Hexagon nuts - ISO metric coarse  
and fine thread, Finish C

UNI 5712

(1975) High-strength large hexagon bolts  
for structural engineering - ISO metric  
coarse thread

UNI 5713

(1975) High-strength large hexagon nuts  
for structural engineering - ISO metric  
coarse thread

UNI 5714

(1975) Chamfered plain washers for  
high-strength bolts for structural  
engineering

UNI 5727

Hexagon head bolts - ISO metric coarse

	pitch thread, product grade C
UNI 5743	(1966) Metallic protective coatings of ferrous materials - Zinc layer uniformity test on hot galvanized materials - Preece test
UNI 6127	(1998) Concrete specimens for strength tests - Making and curing
UNI 6130-1	(1980) Concrete specimens for mechanical resistance tests - Form and sizes
UNI 6130-2	(1980) Concrete specimens for mechanical resistance tests - Moulds
UNI 6132	(1972) Destructive tests of concretes - Compression test
UNI 6687	(1973) Cement mortar - Hydraulic shrinkage determination - Laboratory test
UNI 7451	(1984) Malleable iron sand castings - Deviations for dimensions without tolerance indication and machining allowances
UNI 7548-1	(1992) Lightweight concrete by expanded clay or shale - Definition and classification
UNI 7549-1	(1976) Lightweight aggregates - Definition, classification and grading
UNI 7549-2	(1976) Lightweight aggregates - Visual identification of expanded shales and clays
UNI 7549-3	(1976) Lightweight aggregates - Sieve or screen analysis
UNI 7549-4	(1976) Lightweight aggregates - Determination of the bulk unit weight
UNI 7549-5	(1976) Lightweight aggregates - Determination of the unit weight of particle
UNI 7549-6	(1976) Lightweight aggregates - Determination of the water absorption coefficient
UNI 7549-7	(1976) Lightweight aggregates - Determination of strength of particles

UNI 7549-8	(1976) Lightweight aggregates - Determination of the potential degree of staining
UNI 7549-9	(1976) Lightweight aggregates - Determination of the loss on ignition
UNI 7549-10	(1976) Lightweight aggregates - Determination of the freezing resistance
UNI 7549-11	(1976) Lightweight aggregates - Determination of the soundness by autoclave test
UNI 7549-12	(1976) Lightweight aggregates - Evaluation of the properties by standard lab concrete tests
UNI 8520-1	(1999) Aggregates for use in concretes - Definition, classification and properties
UNI 8520-2	(1997) Aggregates for use in concretes - Requirements
UNI 8520-7	(1984) Aggregates for use in concretes - Determination of the sieved at 0,075 UNI 2332
UNI 8520-8	(1999) Aggregates for use in concretes - Determination of clay lumps and friable particles
UNI 8520-13	(1984) Aggregates for use in concretes - Determination of density and water absorption of fine aggregates
UNI 8520-15	Aggregates for use in concretes - Determination of the equivalent in sand
UNI 8520-16	Aggregates for use in concretes - Determination of density and water absorption of coarse aggregates. (hydrostatic balance and cylinder methods)
UNI 8520-17	(1984) Aggregates for use in concretes - Compression test of coarse aggregates
UNI 8520-21	(1999) Aggregates for use in concretes - Comparison in concrete with aggregates of known characteristics
UNI 8520-22	(1999) Aggregates for use in concrete - Determination of potential reactivity of alkali in aggregates

UNI 8926	(1986) Steel wires to be used in manufacturing of electrically welded fabrics and lattice girders for the reinforcement of concrete
UNI 8927	(1986) Electrically welded steel fabrics and lattice girders for the reinforcement of concrete
UNI 8981-7	(1989) Durability of concrete works - Criteria for mix design, mixing and placing of concrete
UNI 10622	(1997) Zinc-coated (galvanized) steel bars and wire rods for concrete reinforcement
UNI 10765	(1999) Admixtures for concrete - Multifunctional admixtures for concrete - Definitions, requirements and conformity criteria
UNI 11001	(1962) Code of practice for edge preparation in fusion welding of steel structures
UNI ISO 10287	(1995) Steel for reinforcement of concrete - Determination of strength of joints in welded fabric
SS UNI U50.00.206.0	Formworks - General requirements for design, construction and use

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)  
(UNI EN ISO)(UNI ISO)

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**NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.**

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UNI CNR 10020	(1971) Beam test on steel bars
UNI EN 196-1	(1996) Methods of testing cement - Determination of strength
UNI EN 196-2	(1996) Methods of testing cement - Chemical analysis of cement

UNI EN 196-3	(1996) Methods of testing cement - Determination of setting time and soundness
UNI EN 196-4	Methods of testing cement - Quantitative determination of constituents
UNI EN 196-5	(1996) Methods of testing cement - Pozzolanicity test for pozzolanic cements
UNI EN 196-6	(1991) Methods of testing cement - Determination of fineness
UNI EN 196-7	(1991) Methods of testing cement - Methods of taking and preparing samples of cement
UNI EN 196-21	(1991) Methods of testing cement - Determination of the chloride, carbon dioxide and alkali content of cement
UNI EN 197-1	(2001) Cement - Part 1: Composition, specifications and conformity criteria for common cements
UNI EN 197-2	(2001) Cement - Part 2: Conformity evaluation
UNI EN 206-1	(2001) Concrete - Part 1: Specification, performance, production and conformity
UNI EN 450	(1995) Fly ash for concrete - Definitions, requirements and quality control
UNI EN 451-1	(1996) Method of testing fly ash - Determination of free calcium oxide content
UNI EN 898-1	(2001) Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs
UNI EN 934-2	(2002) Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions and requirements
UNI EN 1363-1	(2001) Fire resistance tests - Part 1: General requirements
UNI EN 1363-2	(2001) Fire resistance tests - Part 2: Alternative and additional procedures
UNI EN 1367-1	(2001) Test for thermal and weathering properties of aggregates - Determination of resistance to freezing and thawing
UNI EN 1367-2	(2001) Test for thermal and weathering

	properties of aggregates - Magnesium sulfate test
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI ENV 1992-1-3	(1995) Eurocode 2: Design of concrete structures - Part 1-3: General rules - Precast concrete elements and structures
UNI ISO 2081	(1989) Metallic coatings - Electroplated coatings of zinc on iron or steel
UNI EN 10025/A1	(1995/96) Hot rolled products of non-alloy structural steels - Technical delivery conditions
UNI ISO 10065	(1994) Steel bars for reinforcement of concrete - Bend and rebend test
UNI ENV 10080	(1997) Steel for the reinforcement of concrete - Weldable ribbed reinforcing steel B 500 - Technical delivery conditions for bars, coils and welded fabric
UNI EN 12350-7	(2002) Testing fresh concrete - Air content - Pressure methods
UNI EN 12620	(2000) Aggregates for concrete
UNI EN 13055-1	(1997) Lightweight aggregates - Part 1: Lightweight aggregates for concrete and mortar
UNI EN 20898-2	(1994) Mechanical properties of fasteners - Part 2: Nuts with specified proof load values - Coarse threads

NATIONAL RESEARCH COUNCIL (CNR)

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**NOTE:** The C.N.R. (National Research Council) is an organization that issues technical standards, norms, and technical specifications, together with certifications, tests, and crediting for Public Administrations at their request. The C.N.R. also provides for the compilation of norms for the acceptance, testing and unification of materials, instruments, equipment, machinery and various accessories for scientific and technical use, execution of norms, testing and protection of systems and construction. C.N.R. norms are



available only in the Italian language.

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CNR 10018 (1987) Rubber and PTFE pads for  
constructions - Instructions for the  
design and installation

## 1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members [except that precast concrete wall panels shall be provided as specified in Section 03450, "Plant-Precast Architectural Concrete"]. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. The advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

## 1.3 SUBMITTALS

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NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significantly to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

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Submit the following in accordance with Section 01330, "Submittal Procedures."

### SD-02 Shop Drawings

Drawings of precast members; G

### SD-03 Product Data

Anchorage and lifting inserts and devices; G

Bearing pads; G

### SD-04 Samples

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NOTE: Sample panels should only be required when a finish Grade A or better is specified.

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Surface finish; G

Submit two 300 by 300 by 50 mm thick sample panels representative of the color and finish for each type of precast member.

#### SD-05 Design Data

Precast concrete members design calculations; G

Concrete mix design; G

#### SD-06 Test Reports

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**NOTE: Require aggregate quality testing on large concrete projects where concrete is exposed to seawater, alkali soils, moist conditions, or the quality of aggregates is questionable.**  
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Contractor-furnished mix design; G

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. The laboratory test reports shall include mill test and other tests for cement, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage versus sieve size. Test reports shall be submitted along with concrete mix design. Obtain approval before concrete placement.

[Aggregates; G]

[Submit test results for aggregates in accordance with UNI 8520-22 for potential alkali reactions.] [Submit tests for aggregate size and gradation in accordance with UNI EN 12620.]

#### SD-07 Certificates

Fabrication

Submit quality control procedures established in accordance with UNI ENV 1992-1-3 by the precast manufacturer.

[Admixtures]

#### SD-11 Closeout Submittals

Concrete batch ticket information

### 1.4 QUALITY ASSURANCE

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**NOTE: Edit when precast members are to be fire rated. On most large jobs, not all members will**

have the same fire rating, so fire ratings for each specific member should be indicated for clarity.

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NOTE: When concrete toppings are indicated, they are normally allowed to be used in establishing the design strength of the precast member. However, areas where the topping is not the full thickness, and areas without topping located inside of larger areas with topping need to be indicated so that the topping is not used in the untopped areas to establish the design strength of the precast members.

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#### 1.4.1 Precast Concrete Member Design

Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. [Precast members [where indicated] shall have a fire rating [of [\_\_\_\_]-hours] [as indicated] as designed in accordance with UNI EN 1363-1 and UNI EN 1363-2.] [Concrete toppings shall [not] be used in establishing the design strength of the precast members.]

#### 1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

#### 1.6 PLANT INSPECTION

At the option of the Contracting Officer, [precast units may be inspected by the Contracting Officer] [precast units shall be inspected by the QC Representative] prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

#### 1.7 QUALITY ASSURANCE

##### 1.7.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

- a. Marking of members for erection
- b. Connections for work of other trades
- c. Connections between members, and connections between members and other construction
- d. Location and size of openings
- e. Headers for openings
- f. Joints between members, and joints between members and other construction
- g. Reinforcing details
- h. Material properties of steel and concrete used
- i. Lifting and erection inserts
- j. Dimensions and surface finishes of each member
- k. Erection sequence and handling requirements
- l. All loads used in design (such as live, dead, handling, and erection)
- m. Bracing/shoring required
- n. Areas to receive toppings, topping thickness.

#### 1.7.2 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, demonstrating compliance with Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions and indicated loading conditions; and submitted for approval prior to fabrication.

#### 1.7.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type, brand, source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least 3 different water-cement ratios for each type of mixture, that will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise

approved in writing by the Contracting Officer. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes.

#### 1.7.4 Certificates: Record Requirement

UNI EN 206-1. Submit mandatory batch ticket information for each load of ready-mixed concrete.

## PART 2 PRODUCTS

### 2.1 SOURCE MANUFACTURERS

#### 2.1.1 Precast Concrete

The following manufacturers comply with these specifications:

ITALCEMENTI  
Via San Bernardino, 149/A  
24126 Bergamo  
Tel: 035/4167111  
Fax: 035/4167046  
Web Site: [www.calcestruzzi.it](http://www.calcestruzzi.it)

MAC S.p.A.  
Via Vicinale delle Corti, 21  
31100 Treviso  
Tel: 0422/304251  
Fax: 0422/421802  
Web Site: [www.mac-mbt.com](http://www.mac-mbt.com)

Other manufacturers are acceptable, provided that they demonstrate both products and production process are in compliance with all the codes specified herein by submitting adequate certifications.

### 2.2 CONTRACTOR-FURNISHED MIX DESIGN

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NOTE: Normal precast design is based on concrete having a compressive strength of 35 MPa at 28 days. Some precast manufacturers like to speed up production by using high early strength concrete conforming to requirements of UNI EN 197-1, Table 2, paragraph 7.1.2.

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NOTE: Delete air entraining requirements when the project is located in a nonfreezing climate.

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NOTE: Designer shall review EN 206-1 for the variety

of choices defined and revise this specification accordingly.

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Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions. The minimum compressive strength of concrete at [28] [\_\_\_\_\_] days shall be [35 MPa] [\_\_\_\_], producing a class [C35/45] [\_\_\_\_] concrete unless otherwise indicated. [Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.] The consistency of the concrete prior to placement shall produce a range of slump of 50-90 mm [\_\_\_\_ mm], slump class [52] [\_\_\_\_], using a maximum water-cement ratio of 0.45 by weight. Use 25 to 35 percent (by weight) fly ash or pozzolan, 40 to 50 percent GGBF slag or a combination that is approved by the Contracting Officer. [The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days shall not exceed [0.15] [0.30] [1.00].] [The concrete exposure class shall be Xo, for concrete inside buildings with very low humidity.]

## 2.3 MATERIALS

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NOTE: UNI EN 197-1 and UNI EN 197-2 cover 27 products in the family of common cements. They are grouped into five main cement types (refer to Table 1 of UNI EN 197-1).

The following are acceptable for use:

1. CEM I - Portland cement.

2. CEM II - Portland composite cement that includes the types:

CEM II/A-S, CEM II/B-S Portland-slag cement

CEM II/A-P, CEM II/B-P,  
CEM II/A-Q, CEM II/B-Q Portland-pozzolan cement

CEM II/A-V, CEM II/B-V Portland-fly ash cement

The following are acceptable for use with restrictions on constituent materials or material percentages:

1. CEM II - Portland composite cement that includes the types:

CEM II/A-M, CEM II/B-M Portland-composite cement

2. CEM III - Blast furnace cement, type CEM III/A

3. CEM IV - Pozzolanic cement, type CEM IV/A

4. CEM V - Composite cement, type CEM V/A

The following are not acceptable for use:

1. CEM II - Portland composite cement that includes the types:

CEM II/A-D Portland-silica fume cement

CEM II/A-W, CEM II/B-W Portland-fly ash cement

CEM II/A-T, CEM II/B-T Portland-burnt shale cement

CEM II/A-L, CEM II/B-L,  
CEM II/A-LL, CEM II/B-LL Portland-limestone cement

2. CEM III - Blast furnace cement, that includes the types:

CEM III/B, and CEM III/C

3. CEM IV - Pozzolanic cement, type CEM IV/B

4. CEM V - Composite cement, type CEM V/B

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2.3.1 Cementitious Material

"Cementitious Material" as used herein shall include all portland cement, fly ash, pozzolan and ground granulated blast-furnace slag.

2.3.1.1 Cement

UNI EN 197-1 and UNI EN 197-2, with maximum alkali content of 0.60 percent. Cement certificates shall include test results in accordance with UNI EN 197-1 and UNI EN 197-2, including Equivalent Alkalies. Blended and composite cements shall contain a minimum of 50 percent portland cement by weight of total cementitious materials. [Cement shall be high early strength cement, (Class R).] Cement sampling and testing to verify the compliance of the product with the codes cited above shall be conducted as specified in UNI EN 196-1, UNI EN 196-2, UNI EN 196-3, UNI EN 196-4, UNI EN 196-5, UNI EN 196-6, UNI EN 196-7 and UNI EN 196-21.

2.3.1.2 Fly Ash

UNI EN 206-1 and UNI EN 450, Type (V) Siliceous fly ash, except that the maximum allowable loss on ignition shall be 6 percent and maximum available alkalies shall be 1.5 percent. The maximum allowable calcium oxide (CaO) content shall be 8 percent, as tested in accordance with UNI EN 451-1. Fly ash certificates shall include test results in accordance with UNI EN 206-1 and UNI EN 450 including Available Alkalies. Type (W) Calcareous fly ash

shall not be used.

2.3.1.3 Pozzolan

UNI EN 196-5 and UNI EN 197-1.

2.3.1.4 Ground Granulated Blast-Furnace Slag

Law 595 and UNI EN 197-1.

2.3.1.5 Silica Fume

Silica fume shall not be used.

2.3.1.6 Burnt Shale

Burnt shale shall not be used.

2.3.1.7 Limestone

Limestone shall not be used.

2.3.2 Water

Water shall be fresh, clean, and potable.

2.3.3 Aggregates

2.3.3.1 Aggregates Selection

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**NOTE: Select gradation(s) based on job requirements and constraints. The maximum aggregate size shall not exceed three-quarters the minimum cover over reinforcing. Designer shall review variations of sizes as identified in UNI EN 12620 and revise this specification accordingly.**

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UNI 8520-1, UNI 8520-2, UNI 8520-7, UNI 8520-8, UNI 8520-13, UNI 8520-15, UNI 8520-16, UNI 8520-17, UNI 8520-21, UNI 8520-22, UNI EN 1367-1, UNI EN 1367-2 and UNI EN 12620, Size D/d of 5/15, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

[2.3.3.2 Aggregates for Lightweight Concrete

All aggregates for lightweight concrete as defined in UNI 7548-1 shall comply with UNI 7549-1 and UNI EN 13055-1. Aggregate properties consistent with the requirements specified in UNI 7549-1 shall be verified in accordance with UNI 7549-2, UNI 7549-3, UNI 7549-4, UNI 7549-5, UNI 7549-6,



UNI 7549-7, UNI 7549-8, UNI 7549-9, UNI 7549-10, UNI 7549-11 and UNI 7549-12.

]2.3.4 Grout

2.3.4.1 Nonshrink Grout

UNI 6687, nonmetallic, of type and quality commonly used in the construction of precast elements.

2.3.4.2 Cementitious Grout

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**NOTE: Delete air entraining requirements when the  
project is located in a nonfreezing climate.**  
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Shall be a mixture of Portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. [Provide air entrainment for grout exposed to the weather.]

2.3.5 Admixtures

[2.3.5.1 Air-Entraining

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**NOTE: Delete air entraining requirements when the  
project is located in a nonfreezing climate.**  
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UNI EN 934-2, UNI 10765 and UNI EN 12350-7. [Certify that admixtures are free of chlorides.]

]2.3.5.2 Accelerating

UNI 10765.

2.3.5.3 Water Reducing

UNI 10765.

2.3.6 Reinforcement

Reinforcing bars and welded wire fabric shall conform to Law 1086 and D.M. 9/1/96, or the latest updated revision.

2.3.6.1 Reinforcing Bars

[UNI ISO 10065 and UNI ENV 10080] [or] [UNI 10622], test in accordance with UNI CNR 10020 and UNI 5294.

2.3.6.2 Welded Wire Fabric

UNI 8926, UNI 8927 and UNI ENV 10080, test in accordance with UNI ISO 10287

and UNI 5294.

#### 2.3.7 Metal Accessories

Provide UNI ISO 2081, UNI 5743, or UNI EN ISO 1461, galvanized.

##### 2.3.7.1 Inserts

UNI 7451 or UNI 3160.

##### 2.3.7.2 Structural Steel

UNI EN 10025/A1.

##### 2.3.7.3 Standard Strength Bolts

UNI EN 898-1, UNI 3740-1, and UNI 5727.

##### 2.3.7.4 High Strength Bolts

UNI EN 898-1, UNI 5712, Law 1086 and D.M. 9/1/96, including latest updates and revisions.

##### 2.3.7.4 Nuts

UNI 3740-1, UNI 5591, UNI 5592, UNI EN 20898-2, UNI 5713, Law 1086 and D.M. 9/1/96, including latest updates and revisions.

##### 2.3.7.5 Washers

UNI 3740-1, UNI 5714, plain carbon steel. Law 1086 and D.M. 9/1/96, including latest updates and revisions.

#### 2.3.8 Bearing Pads

##### 2.3.8.1 Elastomeric

CNR 10018, for plain neoprene bearings.

##### 2.3.8.2 Hardboard (Interior Only)

Hardboard in compliance with the precast manufacturer recommendation.

#### 2.4 FABRICATION

UNI ENV 1992-1-3, unless specified otherwise.

##### 2.4.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 200 mm, unless otherwise indicated. Provide threaded or snap-off type form ties. Formwork shall comply with SS UNI U50.00.206.0 .

#### 2.4.2 Reinforcement Placement

Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

#### 2.4.3 Concrete

##### 2.4.3.1 Concrete Mixing

UNI EN 206-1. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

##### 2.4.3.2 Concrete Placing

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NOTE: D.M. 16/1/96 supplements Law 1086; D.M. 16/1/96, para. 6.1.1 states that concrete must not be placed with temperature less than 0 deg. C, unless proper precautions are taken to ensure proper cold weather curing. UNI 8981-7 technical norm states that concrete must be manufactured and cast-in-place at temperature not lower than 10 deg. C, unless proper precautions are taken to ensure proper cold weather curing. No references address hot weather placing. Designer shall include additional requirements as may be necessary for a particular project location.

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UNI 8981-7, Law 1086, and D.M. 16/1/96, unless otherwise specified.

##### 2.4.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 90 degrees C. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

#### 2.4.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.5 mm in width, may be accepted, except that cracks larger than 0.1 mm in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.5 mm in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

#### 2.4.4.1 Unformed Surfaces

Provide a [floated] [steel troweled] finish.

#### 2.4.4.2 Formed Surfaces

Provide surfaces with the following finishes:

\*\*\*\*\*

**NOTE: The following is equivalent to PCI MNL-116  
Commercial Grade for unexposed surfaces.**

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[a. Unexposed Surfaces: Provide a surface finish with concrete produced in forms that produce a rough finish; remove fins and fill large surface blemishes. Sharp edges that will be visible in the finished structure shall be ground down.]

\*\*\*\*\*

**NOTE: The following is equivalent to PCI MNL-116  
Standard Grade for unexposed surfaces.**

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[b. Unexposed Surfaces: Provide a surface finish with concrete produced in smooth forms that do not impart a texture; remove fins and fill large surface blemishes. Sharp edges that will be visible in the finished structure shall be ground down. Surfaces can be painted, but may have surface voids.]

\*\*\*\*\*

**NOTE: The following is equivalent to PCI MNL-116  
Standard Grade for exposed surfaces.**

\*\*\*\*\*

[c. Exposed Surfaces: Provide a surface finish with concrete produced in smooth forms that do not impart a texture; remove fins and fill large surface blemishes. Sharp edges that will be visible in the finished structure shall be ground down. Surfaces can be painted, but may have surface voids. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.]

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**NOTE: The following is equivalent to PCI MNL-116  
Grade B finish for exposed surfaces.**

\*\*\*\*\*

[d. Exposed Surfaces: Provide a surface finish with concrete produced in smooth forms that do not impart a texture; remove fins and fill large surface blemishes. Sharp edges that will be visible in the finished structure shall be ground down. All surface blemishes shall be filled or finished to provide a smooth surface and uniform appearance when painted. Patches shall be

indistinguishable from the surrounding surfaces when dry.]

## PART 3 EXECUTION

### 3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

### 3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. UNI ENV 1992-1-3, for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

### 3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

### 3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

### 3.5 WELDING

UNI 11001, Law 1086, D.M. 9/1/96, and D.M. 16/1/96, including latest updates and revisions for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation.

### 3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than

300 mm in diameter with a diamond tipped core drill.

### 3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using UNI 5743 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

### 3.8 GROUTING

Clean and fill [indicated] keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

### 3.9 SEALANTS

Provide as indicated and as specified in Section 07920, "Joint Sealants."

### [3.10 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300, "Cast-In-Place Concrete."

### ]3.11 SAMPLING AND TESTING

#### 3.11.1 Concrete

Concrete shall be tested periodically in accordance with Law 1086 and D.M. 9/1/96, including latest updates and revisions. All specimens prepared for lab compressive tests shall be in accordance with UNI 6127, UNI 6130-1 and UNI 6130-2. The compressive tests shall be executed as specified by UNI 6132. Compressive tests shall be performed by an Official Laboratory Authorized by the Italian Public Work Ministry.

#### 3.11.2 Steel Reinforcement

Steel reinforcement shall be tested in accordance with UNI CNR 10020, UNI 5294, Law 1086 and D.M. 9/1/96, including latest updates and revisions. Specimen preparation and testing shall conform with UNI ENV 10080.

-- End of Section --